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Canada. Forestry Service (FS).
Information Report PS-X-47
EARLY EFFECTS OF BURNING AND LOGGING IN PINE-MIXEDWOODS.
2.RECOVERY IN NUMBERS OF SPECIES AND GROUND COVER OF
MINOR VEGETATION. / Sidhu, S.S. 1973.

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2. Recovery in Numbers of Species and Ground Cover of Minor Vegetation

by S.S. Sidhu

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CHALK RIVER, ONTARIO
INFORMATION REPORT PS-X-47
DECEMBER, 1973

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II. Recovery In Numbers Of Species and Ground Cover Of Minor Vegetation

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Petawawa Forest Experiment Station
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ABSTRACT

Recovery in number of species and ground cover of minor-vegetation following logging and experimental burning in pine-mixed-woods with standing timber is described in this report.

Following logging there is an increase in percent ground cover and the order of importance of the first 8 species is least affected.

Following experimental burning, the recovery of minor-vegetation is rapid. The percent ground cover and the numbers of species reach the pre-burn levels by the first spring following the burn. Except Geranium (absent or rare on unburned stands), the first 7 species are the same on unburned and burned stands. However, Pteridium, Carex, and Aster become more important while Aralia, Maianthemum and Corylus become less important after burning.

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EARLY CHANGES OF BURNING AND LOGGING IN PINE-MIXEDWOODS

II. Recovery in numbers of species and ground cover of minor vegetation

by

S. S. Sidhu[1/]

INTRODUCTION

This report is second in the series on early effects of burning and logging and deals with the 'Stand Recovery' during the first year following logging and experimental fires. Stand recovery conveys quite different meanings to people of different perceptions and interests. Stand recovery in this report implies the re-establishment of the vegetal cover, number of species and general aesthetic appeal of the logged-burned stands.

The objective of the present study was to follow the recovery in number of species and ground cover of minor vegetation following logging and experimental fires. This kind of information, previously lacking, is needed before the use of prescribed fires (to stimulate pine regeneration) can be recommended as a forestry practice in pine-mixedwoods.

MATERIAL AND METHODS

Description of Study Area

The stands included in this study are the same that were described by Sidhu (1973). These stands formed a part of the 'stand 102' of Brace's study (Brace 1972)[2/]. About 50% of the total volume was logged in December, 1971. After logging, the stands were mostly composed of red and white pine with insignificant volumes of white spruce and minor hardwoods. The stand treatments, slope and stand area are given in Table 1.

1/ National Research Council Postdoctoral Fellow, Petawawa Forest Experiment Station, Chalk River, Ontario. Presently, Ecologist, Nfld. Forest Research Centre, St. John's, NFld.

2/ Brace, L.G. 1972. Assessing silvicultural stand improvement alternatives in pine mixedwoods. 1. Costs and effects of cutting treatments. Internal Rep. PS-27, Petawawa Forest Experiment Station, Chalk River, Ontario.

TABLE 1

STAND TREATMENTS, SLOPES AND STAND-AREAS

Stand	Stand Treatment	Slope		Area (Acres)
		Degrees	Aspect	
102A	Logged, headfire	7 - 12	SW, SSW, W, WNW	4.9
102B-hf	Logged, backfire	12 - 15	S, SE	1.3
102B-bf	Logged, headfire	9	ENE, ESE, SE	1.4
102C	Logged, unburned	0 - 7	N, NE	1.6
102E	Unlogged, unburned	-	-	1.4

bf = backfire
hf = headfire

Ground Cover

All species in the minor vegetation stratum were included in this investigation. The stratum included all the herbs, semishrubs, up to 1 m high stems of shrubs (e.g. Corylus) and tree seedlings. Ground cover here is defined as the ground occupied by perpendicular projections on it of the aerial parts of plant species in the herbaceous stratum.

No ground cover data prior to logging and burning treatments were available. During the 1972 growing season, the vegetation was sampled twice in logged-unburned stands (102C) and several times in logged-burned stands. In 1973, vegetation was sampled twice in unlogged-unburned (102E), logged-unburned and logged-burned stands.

In each of the stands (Table 1) and at each sampling-time twenty quadrats (50 cm x 50 cm) were sampled. The first quadrat was positioned randomly in a stand and subsequent quadrats were placed regularly along transects distributed uniformly over the stand. Border areas, skid trails, fire guards, etc. were excluded from sampling. In 1972 each quadrat was divided into 100 subplots of 5 cm x 5 cm size and ocular estimates of ground cover of species (visible in surface view) were made in each of the subplots. The number of subplots covered by vegetation represented % ground cover (% G.C.) in a quadrat. The data were recorded by species in each quadrat. Average % ground cover and % relative ground cover (% R.G.C.) for each species were calculated as follows:

$$\text{Average \% G.C.} = \frac{\text{Sum \% ground cover in each quadrat}}{20} \quad \ldots (i)$$

$$\text{\% R.G.C.} = \frac{\text{Av. \% ground cover of species (A)}}{\text{Sum Av. \% ground cover of all sp.}} \times 100 \quad \ldots (ii)$$

In 1973 the ground cover was measured using an instrument described by Sidhu and Williams (1973). The height of the instrument was so adjusted as to cover a ground area of 50 cm x 50 cm at each sampling point. Twenty points were sampled in each stand at each time of sampling.

Number Of Species

The number of species is the total number of species present in a stand at each date of sampling. The stands were surveyed by two observers for the species presence.

RESULTS AND DISCUSSION

The results of the present study are presented in the form of cover of minor-vegetation and number of species present at different time intervals following fire in treated and control stands.

An unlogged-unburned stand (102E), was considered as a control for a Logged-Unburned stand (102C) and stand 102C served as a control for Logged-burned stands (102A, 102B-bf, and 102B-hf; Table 1).

Immediately after the fire the forest floor was black and charred. Three days later browned needles and leaves began to drop off the trees and shrubs forming a thin protective blanket on the forest floor. As a result there was little or no loss of released nutrient ash by overland flow and wind. Very little soil erosion by water or wind was observed to occur, although rain showers occurred 3-4 days after burning. Sufficient available moisture and protection against direct insolation provided suitable conditions for the growth of dormant buds in vegetatively-reproducing species and for germination of seeds in seed-reproducing species of minor vegetation. Sprouts and suckers from a number of species (Aralia nudicaulis, Aster macrophyllus, Corylus cornuta, Maianthemum canadense, Pteridium aquilinum) that were present before the fire, appeared two weeks after the fire treatment. A week later seedlings of Convolvulus, Geranium, Polygonum, Prunus pensylvanica, Betula papyrifera, Aralia racemosa, Acer rubrum, and Viburnum acerifolia, Ambrosia artemisiifolia, Corydalis sempervirens appeared in great numbers. All the above mentioned species are important to the appearance of the burned sites as well as for stabilizing the physical and biotic conditions of the sites. After 12 weeks

following the fire about 50% of the ground surface was green. At this time, species reproducing vegetatively accounted for 90% of the vegetal cover whereas seedlings of species reproducing by seeds (except Geranium) contributed little to the total vegetal cover.

By the first spring (1973) following the burn, seedlings of Betula, Panicum and Prunus had disappeared or greatly diminished in numbers, while other species also reproducing by seeds viz. Corydalis, Geranium, Convolvulus, Comptonia, Aralia hispida, Rhus typhina appeared in greater numbers than their numbers in fall 1972. In addition to these, several vegetatively reproducing species viz. Rubus allegheniensis, R. pubescens, R. strigosus, Vaccinium, and Viburnum were also more abundant in 1973 than in fall 1972.

The recovery in the number of species after the destructive removal of above-ground parts of minor vegetation is presented in Figs. 1 and 2. In 9 to 12 weeks time the number of species was 80% of their number before the burning. The recovery was slower in a stand burned by a strong headfire (102B-hf, Fig. 1) than in the stand burned by a backfire (102B-bf) on the same day and under the same fire weather index (16). By the spring following the experimental burn, the species numbers were equal or greater than the numbers prior to burning. Almost all the species present before were also present after the fire. The results indicate that there will be little loss in taxonomic diversity as a result of a single prescribed fire in partially logged pine-mixedwoods.

A change in the percent ground cover of minor vegetation is presented in Fig. 3 and Appendices I-IV. In 1972 there was no sampling done on the unlogged-unburned stand. There were only two measurements on a logged-unburned stand in 1972 and all stands in 1973. The points representing these kinds of measurements are joined by straight lines in Fig. 3. The exact growth patterns from Time-1 to Time-2 are not known. At 80 days after the burn (September 1972), the burned stands had almost as much percent ground cover as before burning (Fig. 3). However, the rate of recovery, total percent ground cover (% G.C.) and relative ground cover (R.G.C.) seem to have been affected by time of burning and intensity of fire. The stand burned by headfire (102B-hf, Fig. 3) exhibited a slower recovery at first but gradually overtook the percent ground cover present on its counterpart burned by backfire (102B-bf, Fig. 3). Both these stands were burned under a high fire weather index (16) on July 17, 1972. The ground cover continued to be slightly greater on 102B-hf than 102B-bf (Fig. 3).

The rate of site recovery in terms of % ground cover was significantly effected by the time of burning during the growing season. For example, stand 102A was burned 11 days later than the stands 102B-hf

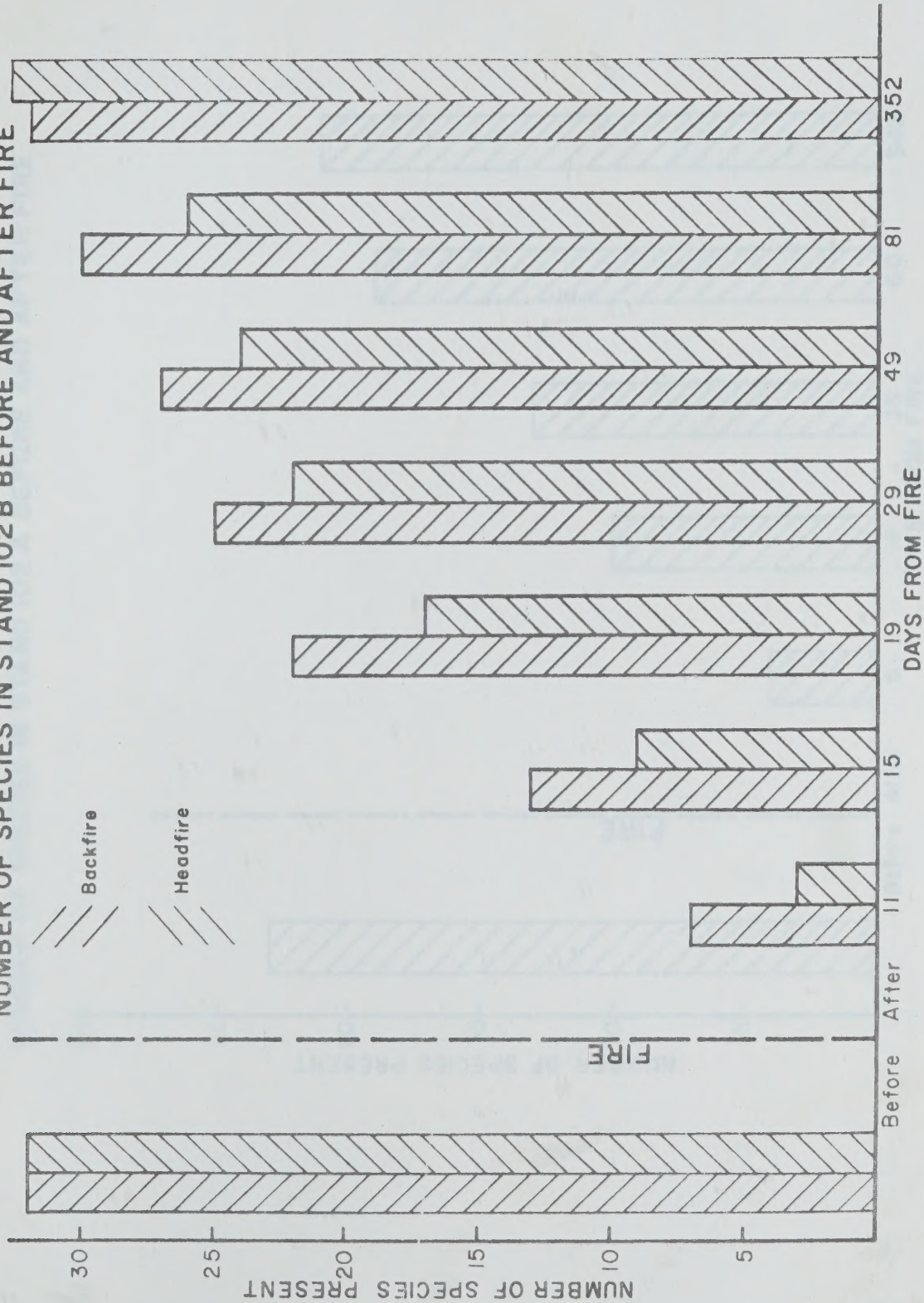

NUMBER OF SPECIES IN STAND 102 B BEFORE AND AFTER FIRE
Backfire
Headfire
FIRE
Before
After
11
15
19
29
49
81
352
DAYS FROM FIRE
NUMBER OF SPECIES PRESENT
5
10
15
20
25
30

FIG. 1

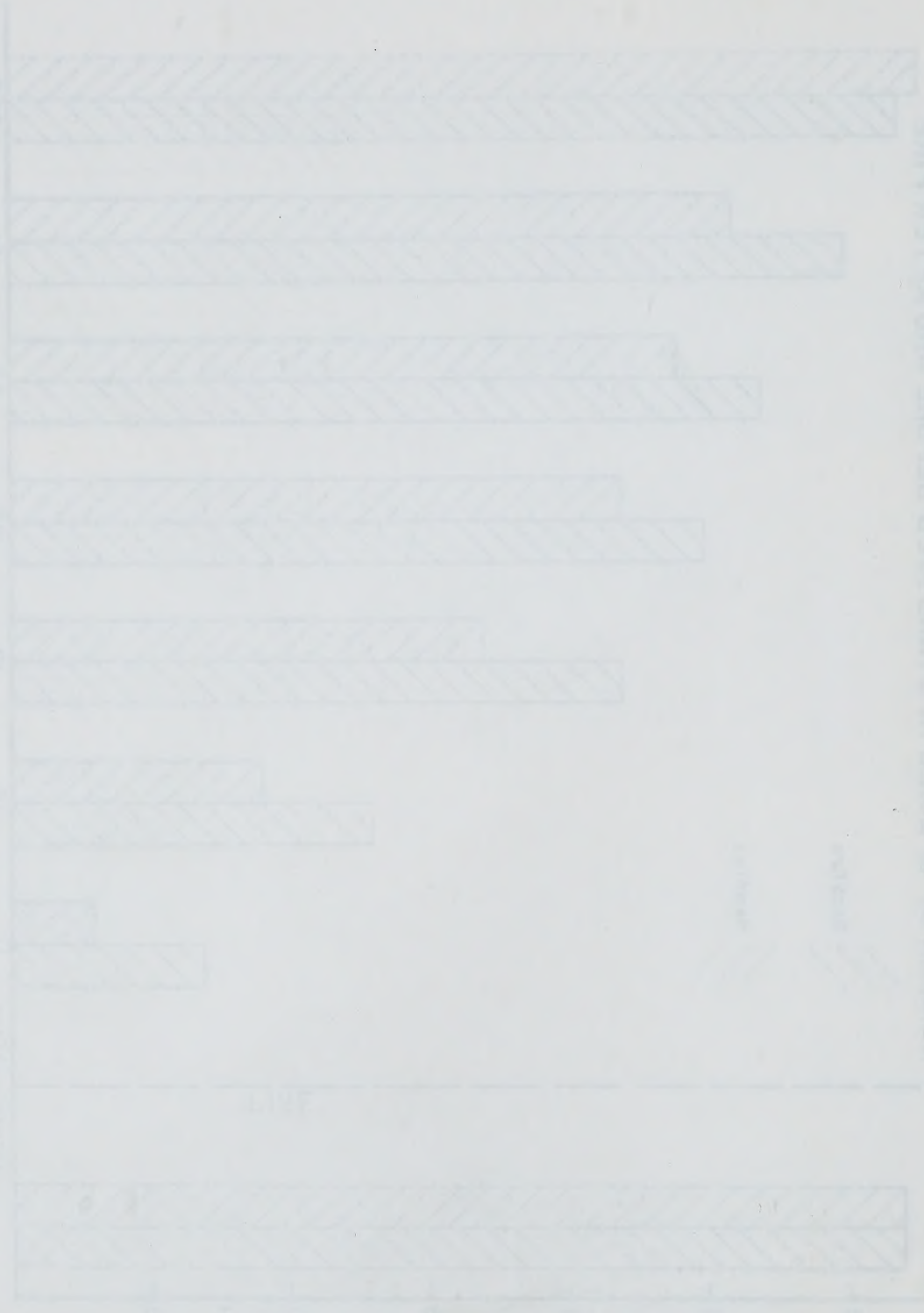


FIG. 2

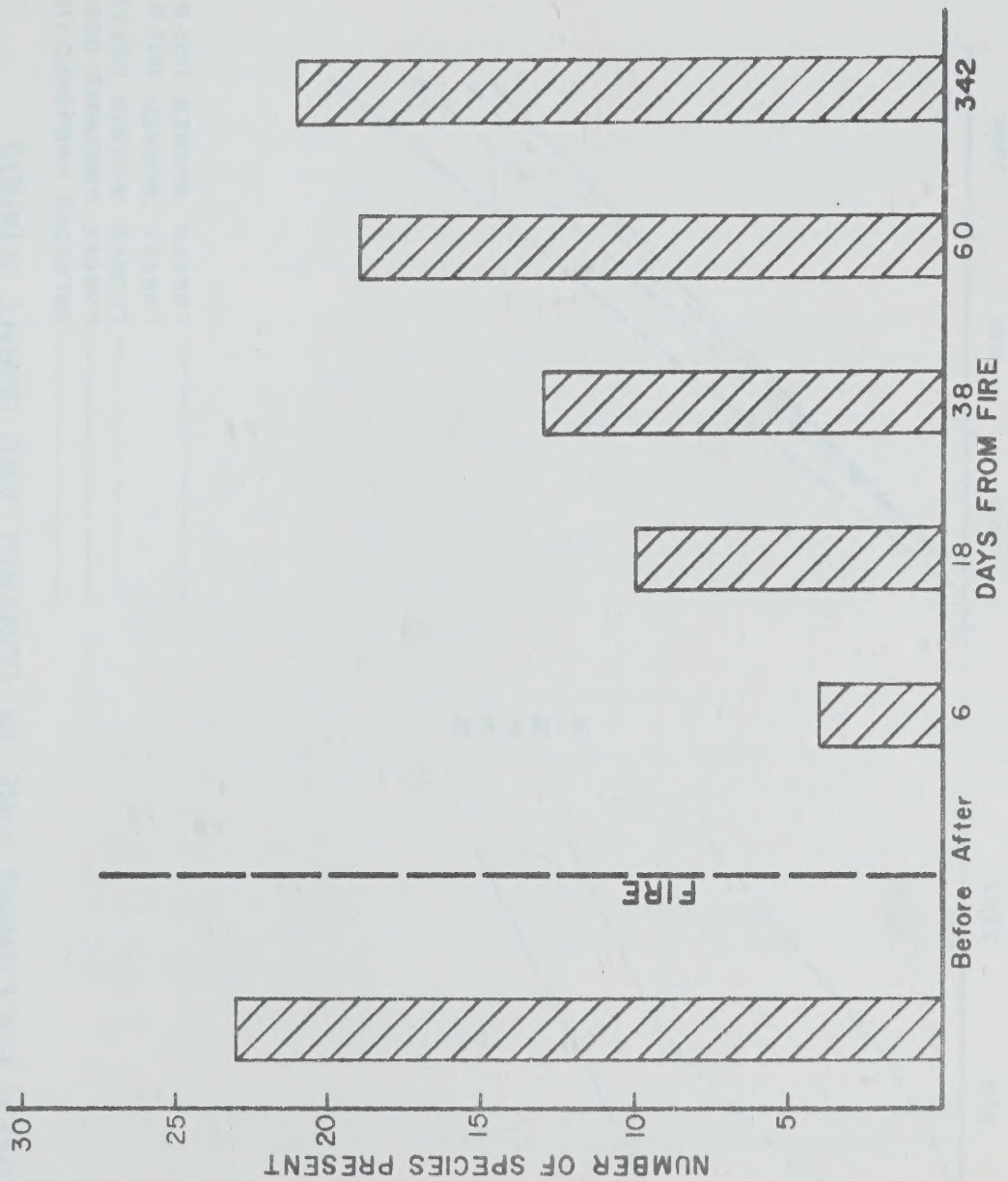
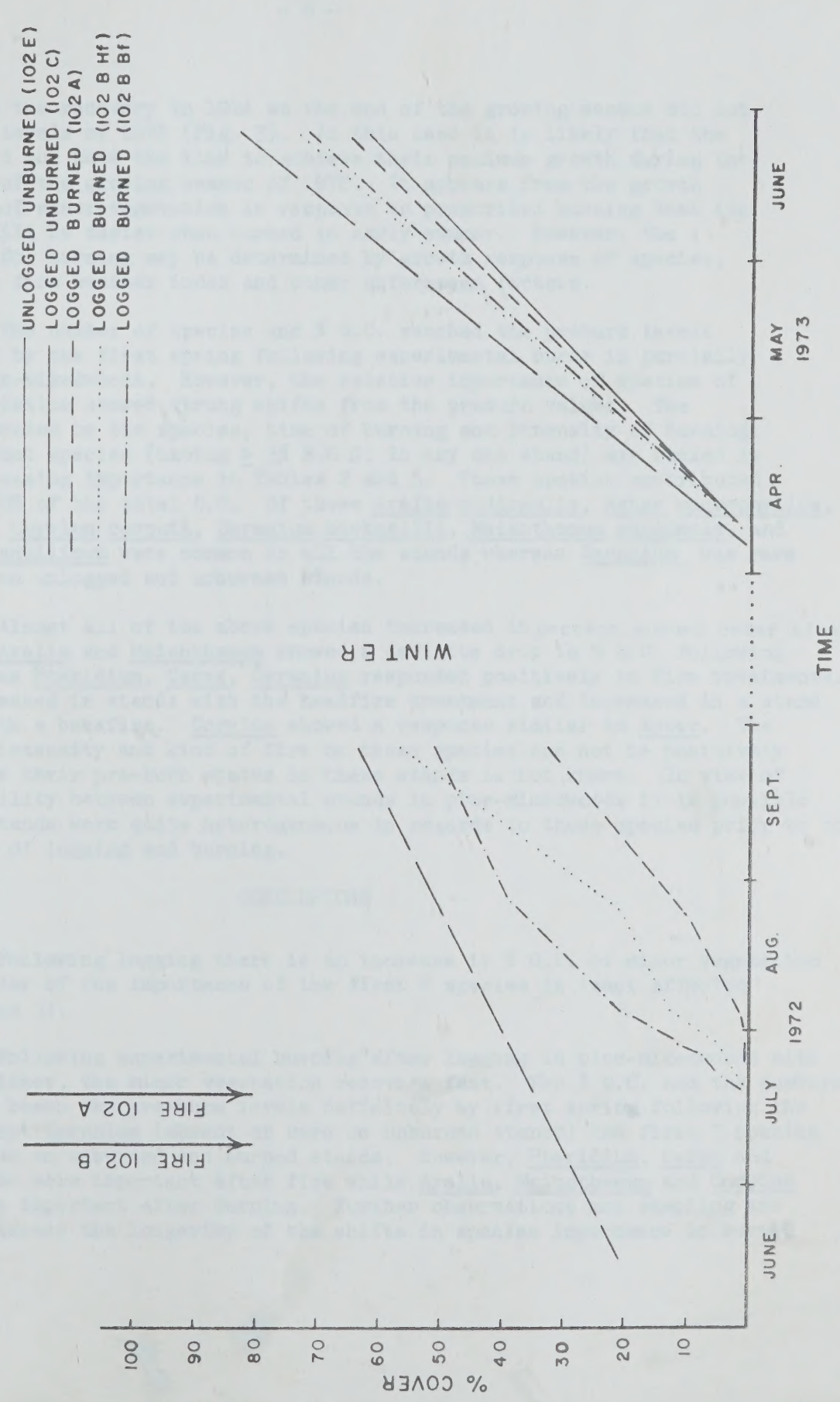

NUMBER OF SPECIES IN STAND 102 A BEFORE AND AFTER FIRE
NUMBER OF SPECIES PRESENT
30
25
20
15
10
5
FIRE
Before
After
6
18
38
60
342
DAYS FROM FIRE

Fig. 3


PERCENT GROUND COVER FOLLOWING FIRE IN CONTROL AND BURNT STANDS
UNLOGGED UNBURNED (102 E)
LOGGED UNBURNED (102 C)
LOGGED BURNED (102 A)
LOGGED BURNED (102 B Hf)
LOGGED BURNED (102 B Bf)
FIRE 102 B
FIRE 102 A
WINTER
% COVER
100
90
80
70
60
50
40
30
20
10
JUNE
JULY
AUG.
SEPT.
APR.
MAY
JUNE
1972
1973
TIME

and bf and the recovery in 102A at the end of the growing season did not reach the levels of 102B (Fig. 3). In this case it is likely that the species did not have the time to achieve their maximum growth during the remainder of the growing season of 1972. It appears from the growth behaviour of minor-vegetation in response to prescribed burning that its recovery will be faster when burned in early summer. However, the schedules for burning may be determined by growth response of species, a suitable fire weather index and other unforeseen factors.

The number of species and % G.C. reached the preburn levels definitely by the first spring following experimental burns in partially logged pine-mixedwoods. However, the relative importance of species of minor vegetation showed strong shifts from the preburn values. The change depended on the species, time of burning and intensity of burning. The important species (having $\geq$ 3% R.G.C. in any one stand) are ranked in their decreasing importance in Tables 2 and 3. These species contributed at least 80% of the total G.C. Of these Aralia nudicaulis, Aster macrophyllus, Carex sp., Corylus cornuta, Geranium bicknellii, Maianthemum canadense, and Pteridium aquilinum were common in all the stands whereas Geranium was rare or absent on unlogged and unburned stands.

Almost all of the above species increased in percent ground cover after logging. Aralia and Maianthemum showed a definite drop in % G.C. following fire whereas Pteridium, Carex, Geranium responded positively to fire treatments. Aster decreased in stands with the headfire treatment and increased in a stand treated with a backfire. Corylus showed a response similar to Aster. The effect of intensity and kind of fire on these species can not be positively assessed as their pre-burn status in these stands is not known. In view of the variability between experimental stands in pine-mixedwoods it is possible that the stands were quite heterogeneous in regards to these species prior to the treatments of logging and burning.

CONCLUSIONS

Following logging there is an increase in % G.C. of minor vegetation and the order of the importance of the first 8 species is least affected (Tables 2 and 3).

Following experimental burning after logging in pine-mixedwoods with standing timber, the minor vegetation recovers fast. The % G.C. and the numbers of species reach the pre-burn levels definitely by first spring following the burn. Except Geranium (absent or rare on Unburned stands) the first 7 species are the same on unburned and burned stands. However, Pteridium, Carex and Aster become more important after fire while Aralia, Maianthemum and Corylus become less important after burning. Further observations and sampling are needed to assess the longevity of the shifts in species importance in burned stands.

TABLE 2

SPECIES[1/] RANKS IN ORDER OF THEIR DECREASING IMPORTANCE BASED ON % RELATIVE GROUND COVER (R.G.C.) IN LOGGED-UNBURNED (L-UB) AND LOGGED-BURNED (L-B) PINE-MIXED WOOD STANDS. (THE DATA WERE COLLECTED ON SEPTEMBER 25, 1972).

102-C L-UB	102-A* L-B	102B-hf** L-B	102B-bf** L-B
Aster macrophyllus	Aster macrophyllus	Pteridium aquilinum	Pteridium aquilinum
Corylus cornuta	Pteridium aquilinum	Carex sp.	Aster macrophyllus
Pteridium aquilinum	Corylus cornuta	Aster macrophyllus	Geranium bicknellii
Aralia nudicaulis	Aralia nudicaulis	Geranium bicknellii	Corylus cornuta
Populus tremuloides	Maianthemum canadense	Corylus cornuta	Aralia nudicaulis
Maianthemum canadense	Carex sp.	Aralia nudicaulis	Carex sp.
Carex sp.	Populus tremuloides	Maianthemum canadense	Populus tremuloides
Geranium bicknellii	Geranium bicknellii	Populus tremuloides	Maianthemum canadense

1/ Species contributing $\geq$ 3% R.G.C. in any one stand are included in this table. For other species see Appendices I-IV.

* Burned July 17/72 by headfire
** Burned July 6/72, hf = headfire, bf = backfire

TABLE 3

SPECIES[1/] RANKS IN ORDER OF THEIR IMPORTANCE BASED ON % RELATIVE GROUND COVER IN UNLOGGED-UNBURNED (UL-UB), LOGGED-UNBURNED (L-UB) AND LOGGED-BURNED (L-B) PINE MIXEDWOOD STANDS. (THE DATA WERE COLLECTED ON JUNE 25, 1973).

102-E UL-UB	102-C L-UB	102-A* L-B	102B-hf**	102B-bf**
Aralia nudicaulis	Aralia nudicaulis	Pteridium aquilinum	Pteridium aquilinum	Aster macrophyllus
Aster macrophyllus	Aster macrophyllus	Carex sp.	Carex sp.	Corylus cornuta
Maianthemum canadense	Corylus cornuta	Aster macrophyllus	Geranium bickenllii	Pteridium aquilinum
Corylus cornuta	Maianthemum canadense	Aralia nudicaulis	Aster macrophyllus	Carex sp.
Pteridium aquilinum	Pteridium aquilinum	Maianthemum canadense	Corylus cornuta	Geranium bicknellii
Carex sp.	Carex sp.	Geranium bicknellii	Maianthemum canadense	Maianthemum canadense
-	-	Corylus cornuta	Aralia nudicaulis	Aralia nudicaulis

1/ Species contributing $\geq$ 3% R.G.C. in any one stand are included in this table. For other species see Appendices I-IV.

* Burned July 17/72 by headfire
** Burned July 6/72, hf = headfire, bf = backfire

N.B. For fire behaviour see Sidhu (1973)

ACKNOWLEDGEMENTS

The author gratefully acknowledges the help of Mr. J.J. Williams for assistance in collecting field-data; help of Mrs. M.I. Moore in identifying difficult species; comments on the manuscript by Dr. J.R. Clements and Messrs. C.E. Van Wagner and I. Methven. The author extends sincere appreciation to Dr. A. Carlisle for reviewing and editing the manuscript.

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APPENDIX I

AVERAGE[a] PERCENT GROUND COVER AT DIFFERENT TIMES

IN STANDS 102C AND 102E

SPECIES	Stand 102C (Logged-Unburned) June 13/72	Stand 102C (Logged-Unburned) September 25/72	Stand 102C (Logged-Unburned) June 25/73	Stand 102E (Unlogged-Unburned) June 25/73
Abies balsamea (Balsam fir)	-	-	X	1.75 (2.73)
Acer rubrum (Red maple)	-	1.50 (2.37)[b]	X	-
Aralia nudicaulis (Wild sarsaparilla)	2.50 (11.41)	4.65 (7.37)	24.50 (29.73)	21.00 (32.86)
Aster macrophyllus	4.40 (20.09)	18.40 (29.18)	16.90 (20.50)	14.00 (21.90)
Betula papyrifera (White birch)	-	2.90 (4.59)	1.25 (1.51)	-
Carex sp.	0.10 (0.45)	0.35 (0.55)	1.00 (1.21)	X
Chimaphila umbellata (Prince's pine)	-	0.15 (0.23)	-	X
Clintonia borealis (Yellow clintonia)	0.50 (2.28)	1.00 (1.58)	-	-
Cornus canadensis (Bunchberry)	0.50 (2.28)	1.45 (2.29)	0.50 (0.60)	0.25 (0.39)
Corylus cornuta (Hazel)	1.00 (4.56)	10.00 (15.86)	13.20 (16.01)	8.25 (12.91)
Diervilla lonicera (Bush-honeysuckle)	-	-	-	0.50 (0.78)
Fragaria virginiana (Common strawberry)	X	X	-	0.75 (1.17)
Gaultheria procumbens (Wintergreen)	0.20 (0.91)	-	X	X

APPENDIX I

(Cont'd)

SPECIES	Stand 102C (Logged-Unburned) June 13/72	Stand 102C (Logged-Unburned) September 25/72	Stand 102C (Logged-Unburned) June 25/73	Stand 102E (Unlogged-Unburned) June 25/73
Goodyera repens (Rattlesnake plantain)	0.20 (0.91)	0.95 (1.50)	-	-
Hepatica americana	X	X	0.50 (0.60)	-
Linnaea borealis (Twin-flower)	0.50 (2.28)	0.50 (0.79)	0.50 (0.60)	-
Maianthemum canadense (Wild Lily of the Valley)	3.50 (15.98)	2.70 (4.28)	11.05 (13.41)	8.75 (13.69)
Mitchella repens	-	0.25 (0.39)	-	-
Oryzopsis asperifolia	3.00 (13.69)	2.15 (3.40)	0.75 (0.91)	0.25 (0.39)
Picea glauca (White spruce)	0.20 (0.91)	0.25 (0.39)	-	-
Pinus strobus	-	-	-	0.25 (0.39)
Populus tremuloides (Trembling aspen)	0.20 (0.91)	3.20 (5.07)	1.50 (1.82)	-
Prunus pensylvanica (Pin cherry)	-	-	1.00 (1.21)	-
Pteridium aquilinum (Bracken fern)	1.00 (4.56)	5.50 (8.72)	5.50 (6.67)	6.25 (9.78)
Pyrola rotundifolia	X	X	X	0.25 (0.39)
Quercus rubra (Red oak)	-	2.15 (3.40)	0.50 (0.60)	-

APPENDIX I

(Cont'd)

SPECIES	Stand 102C (Logged-Unburned) June 13/72	Stand 102C (Logged-Unburned) September 25/72	Stand 102C (Logged-Unburned) June 25/73	Stand 102E (Unlogged-Unburned) June 25/73
Rubus pubescens (Dwarf blackberry)	-	0.25 (0.39)	X	-
Streptopus roseus	-	-	-	0.25 (0.39)
Trientalis borealis	0.10 (0.45)	0.45 (0.71)	1.00 (1.21)	0.40 (0.62)
Vaccinium angustifolium (Low bush blueberry)	3.00 (13.69)	3.15 (4.99)	1.75 (2.12)	X
Vaccinium myrtilloides (Sour-top blueberry)	0.50 (2.28)	1.15 (1.82)	1.00 (1.21)	1.00 (1.56)
Waldsteinia fragarioides (Barren strawberry)	0.50 (2.28)	-	X	X
Total % Ground Cover	21.9	63.05	82.40	63.9

[a]Average is mean of % G.C. of a species in 20 1/2 m x 1/2 m quadrats

[b]Values in parentheses are % relative ground cover

X = Species present but with insignificant cover

N.B. Total % ground cover values for April, 1973 were $\leq$ 1% for all stands, therefore not recorded by species.

APPENDIX II

AVERAGE[a] PERCENT GROUND COVER AT DIFFERENT TIMES

FOLLOWING FIRE IN STAND 102A - HEADFIRE

SPECIES	SAMPLING DATE				
	July	August		Sept	June
	25/72	4/72	24/72	25/72	25/73
Acer rubrum (Red maple)	-	-	0.05 (0.43)[b]	X	-
Aralia nudicaulis (Wild sarsaparilla)	X	X	1.25 (10.96)	5.60 (16.49)	5.95 (9.49)
Aster macrophyllus	X	0.10 (7.70)	1.25 (10.96)	8.25 (24.30)	9.45 (15.08)
Aster ciliolatus	-	X	X	X	-
Betula papyrifera (White birch)	X	X	X	0.20 (0.58)	X
Carex sp.	-	X	0.05 (0.43)	1.40 (4.12)	10.90 (17.39)
Clintonia borealis (Yellow clintonia)	-	-	-	0.10 (0.29)	1.00 (1.59)
Corylus cornuta (Hazel)	-	X	0.30 (2.63)	5.70 (16.78)	1.00 (1.59)
Diervilla lonicera	-	-	-	-	0.50 (0.79)
Gaultheria procumbens (Wintergreen)	-	-	-	0.20 (0.58)	X
Geranium bicknellii	-	X	0.30 (2.63)	X	3.00 (4.78)
Lycopodium lucidulum (Club moss)	-	-		0.05 (0.14)	-
Maianthemum canadense (Wild Lily of the Valley)	-	-	0.25 (2.19)	2.05 (6.03)	3.60 (5.74)
Mitchella repens	-	X	X	X	-

APPENDIX II

(Cont'd)

SPECIES	SAMPLING DATE July 25/72	August 4/72	August 24/72	Sept 25/72	June 25/73
Oryzopsis asperifolia	-	-	-	0.85 (2.50)	1.75 (2.79)
Populus tremuloides (Trembling aspen)	-	-	X	0.80 (2.35)	0.25 (0.39)
Pteridium aquilinum (Bracken fern)	X	1.20 (92.30)	7.95 (69.73)	8.25 (24.30)	24.50 (39.10)
Rubus pubescens (Dwarf blackberry)	-	X	X	X	-
Vaccinium angustifolium (Low bush blueberry)	-	-	-	-	0.50 (0.79)
Vaccinium myrtilloides (Sour-top blueberry)	-	-	-	0.50 (1.47)	0.25 (0.39)
Total % Ground Cover	0.5	1.30	11.40	33.95	62.65

[a]Average % G.C. is the mean of % G.C. of a species in 20 1/2 m x 1/2 m quadrats

[b]Values in parentheses are % relative ground cover

X = species present with insignificant % G.C.

N.B. Total % Ground Cover for April, 1973 was $\leq$ 1%, therefore not recorded by species.

APPENDIX III

AVERAGE[a] PERCENT GROUND COVER AT DIFFERENT TIMES

FOLLOWING FIRE IN STAND 102B - HEADFIRE

	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
SPECIES	17	21	25	4	24	25	25
Acer rubrum (Red maple)	-	X	X	X	X	X	-
Agropyron repens (Quack grass)	-	-	-	-	0.25 (1.19)	-	-
Amelanchier sp.	-	-	-	-	X	0.25 (0.43)[b]	0.25 (0.33)
Apocynum androsaemifolium	-	-	-	0.05 (0.37)	0.20 (0.95)	X	-
Aralia nudicaulis (Wild sarsaparilla)	X	X	X	0.05 (0.37)	2.05 (9.78)	0.65 (1.14)	2.70 (3.62)
Aster macrophyllus	X	X	X	0.85 (6.31)	2.55 (12.17)	9.00 (15.83)	11.40 (15.32)
Betula papyrifera (White birch)	-	X	X	X	X	0.90 (1.58)	-
Carex sp.	X	X	X	0.60 (4.46)	1.70 (8.11)	9.25 (16.27)	15.00 (20.16)
Comptonia peregrina (Sweet fern)	-	-	-	-	-	0.10 (0.17)	X
Convolvulus spithamaeus	-	-	X	0.25 (1.85)	X	0.30 (0.52)	X
Cornus canadensis	-	-	-	-	-	-	0.10 (0.13)
Corylus cornuta (Hazel)	-	X	X	X	X	3.20 (5.62)	9.10 (12.23)
Diervilla lonicera (Bush honeysuckle)	-	X	X	X	X	X	X
Gaultheria procumbens (Wintergreen)	-	-	-	-	-	0.15 (0.26)	X

APPENDIX III

(Cont'd)

SPECIES	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
	17	21	25	4	24	25	25
Geranium bicknellii	-	X	X	0.20 (1.48)	6.00 (28.63)	6.95 (12.22)	13.10 (17.60)
Maianthemum canadense (Wild Lily of the Valley)	-	-	X	X	0.15 (0.71)	0.35 (0.61)	1.85 (2.48)
Oryzopsis asperifolia	-	-	X	X	0.50 (2.38)	X	0.60 (0.80)
Polygonum cilinode (Fringed bindweed)	-	-	X	X	2.80 (13.36)	0.50 (0.87)	X
Populus tremuloides (Trembling aspen)	-	-	-	0.30 (2.23)	0.30 (1.43)	0.25 (0.43)	X
Prunus pensylvanica (Pin cherry)	-	X	X	X	X	0.50 (0.87)	-
Prunus virginiana (Choke-cherry)	-	-	-	X	X	X	-
Pteridium aquilinum (Bracken fern)	-	X	X	11.15 (82.89)	4.45 (21.24)	22.50 (39.57)	19.90 (26.74)
Rubus pubescens (Dwarf blackberry)	-	-	X	X	X	0.50 (0.87)	-
Rubus allegheniensis (Blackberry)	-	X	X	X	X	1.25 (2.19)	X
Rubus strigosus	-	-	X	X	X	X	0.15 (0.20)
Vaccinium angustifolium (low bush blueberry)	-	-	-	X	X	0.10 (0.17)	0.25 (0.30)

APPENDIX III

(Cont'd)

SPECIES	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
	17	21	25	4	24	25	25
Vaccinium myrtilloides (Sour-top blueberry)	-	-	-	X	X	0.05 (0.08)	X
Waldsteinia fragarioides (Barren strawberry)	-	-	-	X	X	0.10 (0.17)	X
Total % Cover	1	2	5	13.45	20.95	56.85	74.40

[a]Average % G.C. is the mean of G.C. of a species in 20 1/2 m x 1/2 m quadrats

[b]Values in parentheses are % relative ground cover

X = species present but with insignificant cover

N.B. Total % ground cover for April, 1973 was $\leq$ 1%, therefore not recorded by species

APPENDIX IV

AVERAGE[a] PERCENT GROUND COVER AT DIFFERENT TIMES

FOLLOWING FIRE IN STAND 102B - BACKFIRE

SPECIES	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
	17	21	25	4	24	25	25
Acer rubrum (Red maple)	X	X	X	X	0.60 (1.53)[b]	X	-
Achillea millefolium (Yarrow)	-	-	-	X	0.05 (0.12)	X	-
Apocynum androsaemifolium	-	-	X	X	0.4 (1.02)	X	X
Aralia nudicaulis (Wild sarsaparilla)	X	X	X	X	0.85 (2.17)	3.40 (6.50)	1.10 (1.50)
Aster macrophyllus	X	X	X	0.40 (1.80)	4.65 (11.90)	11.80 (22.56)	33.50 (45.76)
Aster ciliolatus	-	-	X	X	X	X	-
Betula papyrifera (White birch)	-	X	X	X	X	0.15 (0.28)	X
Carex sp.	X	X	X	X	0.90 (2.30)	2.60 (4.97)	7.00 (9.56)
Clintonia borealis	-	-	-	-	-	-	0.50 (0.68)
Convolvulus spithamaeus	X	X	X	X	0.05 (0.12)	X	X
Cornus canadensis (Bunchberry)	-	-	-	-		0.20 (0.38)	X
Corylus cornuta (Hazel)	X	X	X	X	3.70 (9.47)	4.45 (8.50)	12.75 (17.41)
Diervilla lonicera (Bush honeysuckle)	-	-	-	-	-	-	-

APPENDIX IV

(Cont'd)

SPECIES	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
	17	21	25	4	24	25	25
Fragaria virginiana (Common strawberry)	-	-	X	X	X	X	-
Gaultheria procumbens (Wintergreen)	-	-	-	-	0.10 (0.25)	X	X
Geranium bicknellii	-	X	X	X	1.60 (4.09)	4.50 (8.60)	3.75 (5.12)
Maianthemum canadense (Wild Lily of the Valley)	-	-	X	X	0.10 (0.25)	0.45 (0.86)	2.10 (2.86)
Mitchella repens	-	-	-	X	X	X	-
Oryzopsis asperifolia	-	X	X	X	X	0.45 (0.86)	X
Polygonum cilinode (Fringed bindweed)	-	X	X	X	X	X	X
Populus tremuloides (Trembling aspen)	-	X	X	2.00 (9.04)	3.40 (8.70)	2.50 (4.78)	0.75 (1.02)
Prenanthes altissima (White lettuce)	-	-	X	X	X	X	-
Prunus pensylvanica (Pin cherry)	-	X	X	X	X	1.35 (2.58)	-
Pteridium aquilinum (Bracken fern)	X	X	X	19.60 (88.68)	22.40 (57.36)	18.00 (34.41)	10.75 (14.68)
Pyrola secunda	-	-	-	-	-	X	-
Quercus rubra (Red oak)	-	-	-	-	-	0.75 (1.43)	-
Rubus pubescens (Dwarf blackberry)	-	-	-	X	0.05 (0.12)	0.20 (0.38)	X
Rubus allegheniensis (Black	-	-	X	0.10 (0.45)	X	X	X

APPENDIX IV

(Cont'd)

SPECIES	SAMPLING DATE						
	July/72			August/72		Sept/72	June/73
	17	21	25	4	24	25	25
Rubus strigosus	-	-	X	X	X	X	X
Vaccinium angustifolium (Low bush blueberry)	-	-	X	X	X	1.10 (2.10)	0.25 (0.34)
Vaccinium myrtilloides (Sour-top blueberry)	-	-	-	X	0.20 (0.51)	0.35 (0.66)	0.75 (1.02)
Viburnum acerifolium (Maple leaf viburnum)	-	-	X	-	-	-	-
Viola sp.	-	-	-	-	X	0.05 (0.09)	X
Waldsteinia fragaroides (Barren strawberry)	-	-	-	X	X	X	-
Total % Cover	1	5	8	22.10	39.05	52.30	73.20

[a]Average is the mean of % G.C. values of a species in 20 1/2 m x 1/2 m quadrats

[b]Values in parentheses are % relative ground cover

X = species present but with insignificant cover

N.B. Total % ground cover for April, 1973 was $\leq$, therefore not recorded by species

Canada, Forestry Serv. Info Rpt. PS-X-47
publishing body report no.
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